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Unveiling Community Needs and Aspirations: Card Sorting as a Research Method for Developing Digital Learning Spaces

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Abstract: This pilot study is part of a larger "Decolonization of Digital Learning Spaces" project, which aims to develop research tools for communities that are remote and/or excluded geographically, politically, economically, socially, culturally, and linguistically. The project's ultimate goal is to work alongside these communities to design their own digital learning tools, networks, and online educational environments by accessing and leveraging their knowledge and skills. Testing the single-criterion card sorting method is the first step toward this goal. Card sorting is an easy, enjoyable, and cost-effective method for data collection and analysis, particularly for researchers working in remote areas with limited access to electricity or the Internet. The pilot explored single-criterion card sorting as a method to elicit knowledge from two diverse cultural and linguistic groups engaged in learning activities within their communities. These groups were from a Deaf and Hard of Hearing (DHH) community in Canada (engaged in a bow-making workshop) and a rural Kabyle community in Algeria (engaged in a traditional cooking lesson). Despite low participant numbers, distinct patterns emerged, indicating the method's effectiveness. The results, though anticipated, were non-random, demonstrating the potential of card sorting in producing patterns indicative of how individuals and/or communities categorize their world(s). Kabyle sortings focused on ingredients, highlighting older individuals as teachers passing along knowledge, while the DHH sortings emphasized face-to-face contact and hand movements in communication. The findings, though modest, established relationships, provided insights into the research context and offered logistical understanding, paving the way for further work with DHH and Kabyle communities towards the design of digital learning spaces.

Keywords: *Card sorting, digital learning spaces, e-learning, marginalized communities, methodology, pile sorting.*

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Introduction

A perennial gnawing source of doubt for reflective education and social science researchers is whether something fundamental within a research context is taken for granted or deemed unworthy of mentioning by the research participants. The missing information could relate to the methods, the topic of research, or some other neglected, unexpected, or unknown factor. Researchers have been addressing this issue since the founding of the various social science disciplines. In psychology, for instance, the double-blind experimental design was developed to factor out various unconscious biases. In social anthropology, researchers would live with the population under study and learn their language to reduce the risks associated with a local interpreter potentially misconstruing and miscommunicating what the researcher intended.

Such concerns have become particularly salient with the replication crisis in psychology (Korbmacher et al., 2023). There is a growing recognition that decolonization is raising profound questions about previously overlooked or

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marginalized topics and *ways of knowing* (for ways of knowing, see: Parrill, 2023). This underscores the increasing need for innovative methodological approaches to address these issues. These questions extend beyond psychology and social anthropology research into other disciplines, such as education and technology, and into international policy-making, particularly regarding the digital divides between Global North and Global South.

Focusing on the field of education, researchers conduct research within specific contexts. Human participants often have an unpredictable array of preferences, motivations, skills, and background knowledge. Thus, as educational researchers, we struggle with generalizability and theory building. Seldom can we *prove* that learning has taken place or the extent to which teaching has been effective or impactful (Fischman et al., 2022). Researchers in education go to great lengths to describe their methodologies, procedures, trustworthiness, and limitations. As Fischman et al. discuss, these indicators of quality may be viewed differently over time. We would argue that they also differ across (and suffer bias from) the cultures, languages, and contexts within research contexts. Our work involving card sorting is part of a larger project in which we carefully interrogate methods that could help us in the field of educational research to overcome bias in language and cultural 'ways of knowing'.

Western conceptions of education often revolve around visions of students sitting in classrooms (i.e., instructionism). Compliance to narrow views of how education is performed can limit explorations in research and practice resulting in less creativity and innovation in the field. In this paper, we are interested in the ways that people learn and how they conceptualize learning. Driscoll (2005) defines learning as "a persisting change in human performance or performance potential . . . as a result of the learner's experience and interaction with the world" (p. 9). Our aim is to move beyond ostensibly accepted conceptions of what learning and education are and how knowledge is passed from person to person—regardless of whether the educational practices are formal, informal, or non-formal. For us, understanding learning within socio-cultural contexts is essential in any discussion, practice, or theorizing of education. In their reflections on Education in the UK, Biesta et al. (2019) note that there is a need to enhance the "usefulness of educational research . . . there is a need for research that identifies problems and, in that sense, causes problems" (p.1). They argue that there is a need to challenge "taken for granted assumptions about what is going on and what should be going on" (p.1). To this end, our team is actively exploring diverse and novel ways to conduct research in education using methods that are not common in the field of education.

In this article, we re-examine a method, card sorts (also known as pile sorts) that has considerable potential for honest and equal engagement between academic researchers and marginalized populations to see whether the assumptions of the card sorts research communities might be missing something fundamental. This is intended to form the basis for later work in the development of digital learning spaces. Such projects will use card sorts if underlying assumptions hold up well to scrutiny. Or, if card sorts do not hold up well to scrutiny, then the projects will use methodological, organizational, and logistical insights from this study to select and/or develop better methods. Our research aims to answer the following question: Do card sorts effectively foster honest and equal engagement between researchers and marginalized populations across potentially wide-ranging educational settings?

Background

This study takes place within the field of educational technology. With decades of computer advancements and integration into world education systems, digital education has become "entwined with matters of global economics and politics, as well as ongoing changes in what 'counts' as knowledge, skills and learning" (Selwyn, 2016, p. 2). Technology is often proffered as a potential panacea for social problems such as lack of access to, high cost of, and varying quality of education[†]. However, the benefits from and enjoyment of such technology remain restricted to those with access to the dominant and/or most valued gender, racial, physiological, cultural, socio-economic, and geopolitical classes. Diverse, remote, and minority communities who wish to access, adopt, and use educational technology for their own purposes and on their own terms should be able to work collaboratively and [equally] with designers, technologists, academics, and big-tech companies to locate the most sustainable and contextually appropriate solutions (e.g., Smith et al., 2024; Thambinathan & Kinsella, 2021). For this reason, it is important to apprehend—as thoroughly as possible—linguistic, cultural, and environmental nuances within which 'marginalized' communities must subsist.

The research project described in this paper was inspired by the work of Professor John Traxler, Commonwealth of Learning (COL) Chair, and UNESCO Chair, himself inspired by Gordon Rugg over the years. The project was initially called, "Decolonization of Digital Learning Spaces". The purpose of the project is to work alongside communities who, for whatever reasons, have been excluded from the dominant political, economic, socio-cultural powers in their societies and help them harness their knowledge and skills to design their own digital learning tools, networks, and environments. Although it is not possible to fully sidestep our Western epistemologies and training, careful selection of knowledge modelling methods may help lessen and/or increase awareness of bias and the perpetuation of English and Western ways of doing and knowing. Meaningful consultation and collaboration can help to ensure that the communities' interests remain at the heart of the project(s) and reduce Western ('outsider') control of research, analysis, development, and dissemination.

[†] It is, however, widely critiqued as the vehicle of digital neo-colonialism.

Literature Review

In practice, instructional designers, learning designers, and other educational practitioners conduct various forms of analyses to understand the tasks, learners, contexts, needs and wants of the people for whom they are designing learning solutions (Parchoma et al., 2020). In the field of human-computer interaction (HCI), human-values design guidelines are emerging (Kheirandish et al., 2020). These fields are founded upon a variety of techniques and procedures for conducting research and analyses which are based upon standard methods such as interviews, observations, document reviews, focus groups, and other methods commonly used in Western research traditions. Our team questioned whether these common methods are effective across linguistic and cultural divides. Not only are there difficulties with the translation of questions and answers, but it is challenging to ask the right questions in ways that are meaningful to diverse, local communities. And of course, questioning is driven by the questioner. To this end, we decided to explore a variety of simple, robust knowledge elicitation methods (Rugg & Gerrard, 2023) that require very little infrastructure and can be employed across a large variety of educational contexts.

Rugg and Gerrard (2023) define knowledge as "information about information" (p. 10) They define information as "structured data" (p. 10). Rather than collecting data or information, our team wishes to understand communities' knowledge structures; that is, what they know and need to know about their world. Knowledge is highly contextual. Accurate modeling of knowledge, in theory, should help researchers, communities, and non-governmental organizations (NGOs) gain a more holistic understanding of specific communities' needs, desires, strengths, weaknesses, and logistical issues. We argue that with a better understanding, more appropriate digital learning spaces can be selected, conceptualized, developed, and sustained by the community and for the community. These points are important because not only are the components of knowledge culturally specific, but so are the structure and organization of knowledge.

Card Sorting in Education and the Social Sciences

Card sorting has long been used in anthropology, and in cross-cultural work (e.g. Hurd, 2001). It has also been used with groups varying widely in educational backgrounds, such as Hungarian cattle herders and professional botanists (Molnár, 2012). Within education, various forms of card sorting have been used to inform government-level categorisation of educational issues (e.g., Taylor & Maxim, 2018), to study teachers' categorisations of topics (e.g. Friedrichsen & Dana, 2003) and to study students' categorisation and learning (e.g., Bissonnette et al., 2017). (NB: The Wisconsin card sorting test is widely used in education, but is a test which uses cards, rather than a form of card sorting in the sense that we use in this article.) It should be possible to use card sorting on even very young students, since there is evidence for categorisation even by children less than two years old (Rakison, 2003).

Study Contexts

In this paper, we focus on a knowledge elicitation method called single-criterion card sorting. Card sorting is well established under that name in various disciplines. It is well established in anthropology, where it is more generally known as pile sorting (Dengah et al., 2020). Market research also use card sorting and examine constraints like robustness, cost-effectiveness, and ease of delivery (e.g., Kordrostami & Laczniak, 2022; Toure et al., 2021). Card sorting is also fairly common in website interface development and usability research (e.g., Jansen et al., 2023; Joseph-Richard & Uhomoibhi, 2024). The core concept is that the participants sort entities, such as images on cards, into groups/piles of their own choice. An example is Molnár's use of cards showing images of different terrains to Hungarian cattle herders, to find how their categorizations of terrains compared both to each other's and to groups such as botanists (Molnár, 2012). (We discuss card sorting in more detail in the methodology section later in this paper.) An attraction of card sorts is that they can be used with little or no need for language; anecdotally, they are consistently reported as being well received by participants across cultures and disciplines (Rugg & McGeorge, 2005). Historically, it appears that card sorts are generally administered by researchers, rather than by local people on their own; this was one of the topics we wished to examine in this study.

To begin, we will provide a background to two of the communities with whom we have been working: a Deaf and Hard of Hearing (DHH) community in Canada and a rural community in Algeria. After briefly describing the context of the communities, we will provide a description of, rationale for, and challenges with card sorting as a preliminary method. Next, we will explain the card-sorting procedures, present our preliminary data, and explain the analysis procedures. The paper provides a discussion of the data and how the data will guide the selection of subsequent knowledge modelling methods that will guide further analysis and hopefully help to gain a better, in-depth understanding of the communities' needs and aspirations that may otherwise remain obscured beneath social, cultural, and linguistic barriers of which Western researchers, 'outsiders', and perhaps the communities themselves might lack awareness. We conclude with a critique of our implementation of the card sorting method and recommendations for subsequent trials.

The two groups included in this study, the Saskatchewan Deaf and Hard of Hearing Services (SDHHS) and the Kabyle community in Algeria, are similar only in their underrepresentation within the dominant social, political, and economic structures of their countries. The selection of these communities is intentional in that our goal is to examine the

potential application of card sorting (and other methods) for use across many diverse cultures. Both groups have been asked to participate in a single-criterion card sorting activity using pictures of a learning event that took place with their communities. To provide a fulsome description of each community, we have used the following categories: geographical location, infrastructure access, social status and roles, language(s), political systems (internal and external), economy, perceptions as a community, and beliefs and values (Figure 1).

Figure 1. Categories for Describing Each Community.

The Kabyle Community

Dr. Touati, one of the authors of this article, grew up in the region and is the facilitator working in Kabylia. He provided the following commentary based on his own lived experiences and available literature about the Kabyle people.

Geographical location: The Kabyle region is in the north of Algeria. It is surrounded by coastal plains to the east and west, to the north by the Mediterranean, and to the south by the High Plateaux (Britannica, n.d.). Mostly mountainous, the most important mountains are the Biban and the Djurdjura Mountains. The Kabyle region comprises a group of villages spread across the plateaus and mountains. There are some cities, the most important of which, are Tizi Ouzou (1,127,608 people), Bejaia (915,835 people), Bouira (695,583 people), and Boumerdes (802,083 people) (World Population Review, 2024). The region has an extensive road network of varying quality, yet some villages still suffer some isolation because of old roads and a lack of transportation infrastructure.

Language(s) and culture: While there was an attempt to reintroduce the 6th century Tifinagh alphabet, Kabyle was written with a modified Latin script (Kabyle language-2024). The Kabyle language is a branch of the Amazigh (Berber) language (Ennaji, 2023). It is worth noting that the oral Kabyle languages differ slightly from one region to another. The Kabyle region follows the same public school system as the rest of Algeria and uses the same textbooks. In the Kabyle region, the Amazigh language is studied at the primary, middle, and secondary levels. In the other regions of Algeria, the Amazigh language subject remains optional. The Kabyle people value education highly (Touati & Traxler, 2019).

People see themselves as Kabyle, Amazigh, Algerian, and African. The majority are Sunni Muslims while less than 1% are of other faiths (World Factbook, 2023). In general, people follow moderate Islam, which is why many women are not veiled. Traditionally, men are responsible for defending land and honour. The men are concerned with all activities outside the home such as work and social relationships. As for women, their main job is to raise children, cook, and take care of the house (Touati & Traxler, 2019). Additional women's duties may include retrieving water from natural springs, taking care of livestock, and helping harvest agricultural crops, especially olives. The culture is slowly changing. While some women stay at home, another generation of educated women are beginning to seek employment outside the home.

Infrastructure access: Although the region has electricity, the summer brings high temperatures and excessive use of air conditioners. The pressure on generators leads to frequent electrical outages. Regarding other energy, most small villages lack fuel supplies and must travel to other villages to get it. Given that Algeria is one of the largest oil producers in the world, the price of fuel remains affordable. In recent months, many (but not all) villages have been connected to a natural gas network.

Internet is readily available in cities, but a limited number of villages have Internet thanks to the availability of a telephone line. More recently, a modern cellular network has been provided by Algeria Telecom and some private companies. The situation is similar for access to social facilities such as hospitals and private clinics. In small villages, healthcare services are very limited, and patients may suffer long journeys before reaching a hospital.

Economy: Despite the abundance of natural resources and centuries-old cultural heritage, investment in tourism remains limited. The region receives some tourists from within the country and from the Algerian community abroad. Perhaps the most prominent things that attract these tourists are the ancient villages, two nature reserves, the coastal areas, archaeological and historical sites, and celebrations such as Yennayer (Amazigh New Year) and the first day of spring.

Olive oil is the main export in the Kabyle region and is sold to various regions in Algeria. To this day, olive oil produced in the area bears a registered trademark to indicate its quality and provenance. Other agricultural products include fish, vegetables, and fruit (Britannica, n.d.). The region produces pottery, silver jewelry, handicrafts, Kabyle traditional costumes, iron tools, and salt. Important industrial zones (such as the Taharacht zone) have appeared in the region, supplying the national and even international markets with various food products. In the past few years, the region has suffered from repeated wildfires, low rainfall, and increased pollution in the valleys.

Emigration has played a major role in the development of Kabyle society despite its harsh mountainous landscapes (MacMaster, 1997). In addition to looking for work in larger Algerian cities, the Kabyle men are considered to have been the first Algerians to immigrate to Europe, especially to France to work in the mines. Now, there are more opportunities for work nationally, especially with the emergence of a more highly educated younger generation.

Political systems (internal and external): The Kabyle region is governed by the Algerian bicameral parliamentary system (World Factbook, 2023). Among the Arabic speakers in Algeria, the Amazigh language and culture are of lower status and remain marginalized politically, ideologically, and socio-economically (Ennaji, 2023). Within the context of Kabyle traditional society, there is a unique system of governance and social organization. Every village has a council which manages the organizational and judicial affairs of the village (Touati & Traxler, 2019). The village council includes the oldest and wisest men. The residents meet to discuss their concerns and their issues at a public space in the centre of each village. In other words, the Kabyle people depend on voluntarism and self-organization. This system of governance is called the Tajamaât and it has been the throbbing heart of Kabylian social organization. However, the Tajamaât appears to have started to lose its vitality and is slowly vanishing.

The Saskatchewan Deaf and Hard of Hearing (DHH) Community

Ms. Macleod and Ms. Richardson are both members of the DHH community and work as American Sign Language (ASL) support professionals for the Saskatchewan Deaf and Hard of Hearing Services (SDHHS). Together, they facilitated the card sorting for this project, they also co-authored and advised on the following description.

Geographical location: Saskatchewan is a land-locked province in Canada. According to Tourism Saskatchewan Canada (n.d.), it covers 651,000 km2 with a population of 1.32 million people. The 2021 national census data indicates that the population of the largest city, Saskatoon, is just under 320,000 people. The province is culturally diverse, with a large Indigenous population and settlers from many different countries, including Britain, Ukraine, Poland, Scandinavia, and increasingly, other parts of the world. Geographically, DHH individuals are dispersed across the province. SDHHS has clients in some of the most remote, northern regions that are only accessible by plane, and which often lack stable communications infrastructure for telephone and Internet access.

Language(s) and culture: Unlike the Kabyle people (above), the DHH of Saskatchewan is not tied to "national or sub-national ethnic and migrant language groups" (Rosen, 2022, p. 159). But, what is similar is that, like the Kabyle, the language of the DHH community lacks recognition within 'mainstream' society in the province. For many years, ASL was not even considered a language; however, "by the 1970s and 1980s, ASL was declared a unique language by several linguists . . . [which] despite its distinct modality from spoken language, carries several linguistic features similar to spoken languages" (Rosen, 2022, p. 169; also see MacDougall, 2022).

Language is often a cornerstone of identity and inseparable from culture (Cripps, n.d.). Even the spelling of the word 'deaf' denotes different meanings depending on whether it is capitalized. With a capital letter, the Deaf acknowledges Deaf Culture (MacDougall, 2022). For the DHH people in Saskatchewan, the use of the words D/deaf is respectful; avoidance of the term is an act of erasure. Members of Deaf Culture are connected through their use of sign language and their engagement and interest in Deaf heritage. Indeed, Cripps maintains that Deaf Culture exhibits Padden's (1980) "sociological criteria for defining a culture" (para. 3); that is, members share a language, values, traditions, norms, and identity. Deaf Culture plays a significant role in preserving language as well as defining their own literature and art (Holcomb, 2023). Many Deaf people are proud to be a part of this cultural group.

Canada signed on to the United Nations Convention on the Rights of Persons with Disabilities (United Nations, 2006), acknowledging the rights of citizens to communicate in sign languages, Braille, and other accessible means, modes, and formats. Yet, in practice, some groups of people in Canada—particularly the Deaf—still have less access to services than others. The source of the inequities is sometimes because of intentional denial of service and, at other times, because of benign neglect.

Infrastructure access: The DHH community in Saskatchewan has endured a general lack of services for many years. Accessibility within the K-12 school system is problematic. There are very few classes tailored to DHH students and

some schools refuse to supply ASL interpreters (Koole, 2024). The Saskatchewan Human Rights Commission (2016) noted that some health professionals in the province were telling parents to avoid ASL in favour of other communications solutions and 'therapies' such as auditory-verbal therapy (AVT), lip reading, and cochlear implants. DHH individuals who live in remote locations have few, if any, services. Too often, there is little to no ASL support for Deaf children in some of the school divisions. The lack of access to language during critical developmental periods can lead to language deprivation syndrome (LDS) (Hall et al., 2017). LDS can lead to cognitive delays and, in the worst cases, to psychiatric disorders. At the very least LDS often results in lower academic achievement and, for many, fewer employment opportunities (Rowley et al., 2022).

DHH individuals are making use of current technologies such as smartphone apps. However, many apps and much of the current assistive technologies (ATs) research focus on real-time translation in ways that privilege the hearing. Gugenheimer et al. (2017) note that ATs are frequently rejected by the deaf community and that they often highlight the need for the Deaf to conform to standards of hearing, thereby reinforcing the subordination of the Deaf.

Economy: As a significant indicator of underrepresentation and overt need, the Canadian Association of the Deaf (2022) posit that "No satisfactory statistics exist regarding the number of deaf people in Canada" (para. 3). Recent national statistics estimate that 5.6% of the population is Deaf (Statistics Canada, 2023). These estimates are in keeping with those of the World Health Organization (2024). This means that of the 1,218,976 people in the province, approximately 68,000 are deaf. However, these statistics are unreliable and fail to differentiate between late deafened, hard of hearing, Deaf (a cultural-linguistic minority), deaf (those with hearing loss), and D/deaf-plus-a-disability (D/deaf plus). Politically, the DHH community is a small but important group for whom current politicians lack economically cost-effective and scalable solutions for providing support. Economically, the lack of training in ASL, bias from potential employers, and cost to accommodate suggests that 5.6% of the population is at risk of underemployment.

Political systems (internal and external): Because DHH individuals are widely dispersed and come from all nationalities, ethnicities, and socio-economic levels, they are only unified by their deafness (and variations thereof). The main lobby group in Saskatchewan is the SDHHS organization, which has made significant inroads into provincial politics. As a result of successful lobbying, in December 2023, ASL and Indigenous Sign Languages became official languages in the province, enshrined in the Accessible Saskatchewan Act (2023). All public-sector bodies in the province must adhere to the law. Yet, actionable guidelines have not yet emerged.

Methodology

The groups who agreed to participate in this pilot study were among the original 12 groups involved in the Decolonisation of Learning Spaces project (described above). For the sake of the pilot's manageability, we limited the number of groups with the intention of expanding the study in the future. The distinctive nature of the two groups involved in the card sorting project was appropriate as it is our goal to test card sorting as a method for eliciting opinions, preferences, and knowledge across different communities. Finally, it is important to note that this paper does not compare the results of the two groups.

Single-Criterion Card Sorting

Card sorting is the preliminary knowledge modeling method we are using to explore people's understanding of 'learning'. With a better understanding of how individuals and communities understand learning, we can assist in conceptualizing and/or improving digital learning spaces such as (but not limited to) websites, videos, and learning management systems. Card sorting is a "method of elicitation of respondents' categorisation of the features that they perceive in a set of entities, be they pictures, words, or items" (Hurd, 2001, p. 18). The method, itself derived from Kelly's (1991) personal construct theory (PCT), deals with how individuals understand their world by creating mental frameworks of how 'constructs' relate to each other. In theory, individuals classify constructs into categories based on differentiating criteria (Rugg & McGeorge, 2005). In this card sorting project, we decided to use pictures to avoid issues of literacy and/or to avoid culturally specific connotations associated with actual words. Part of our challenge has been in exploring how to select depictions of 'learning'.

There are many different types of cards sorts. Card sorts can use text written on cards, images printed on cards, or actual objects. The type that is discussed here is picture-based, repeated single-criterion card sorts in which "the respondents sort the same entities repeatedly, categorizing in terms of a different single attribute ('criterion') each time." (Rugg & McGeorge, 2005, p. 9).

Although card sorts have various strengths, they also have limitations. Rugg and McGeorge (2005) note that while card sorting can be used to explore abstract concepts, it is not recommended when trying to investigate sequencing procedures, trade-offs, knowledge hierarchies, and tacit knowledge. The form of card sorting that we used was designed specifically to elicit people's categorisation of entities (e.g., words, images, or physical items) into groups using overarching criteria (e.g., *age*). It was not designed for use on other forms of knowledge, such as procedural knowledge (e.g., how to use a particular piece of software) or strictly tacit nonverbal knowledge (e.g., how to ride a bicycle). Although it can elicit categorisations, it does not locate those categorisations within a broader context, such as

a taxonomy, or a value chain. Researchers using card sorts often use the method in conjunction with other complementary methods, such as laddering (Hinkle, 1965) to investigate value chains.

Card sorting is an easy, robust method that can be used in contexts where electricity, internet connectivity, and/or digital literacy are not guaranteed. Each sorting can be quickly photographed or jotted down by hand. In addition, our team has developed Java-based software into which the sorting data can be uploaded and exported into 'heat maps' (or 'matrices'). The output can then be used in the analysis. The analysis involves identifying commonalities in criteria, similarities between participants and/or groups of participants, identifying possible 'superordinate' constructs, and identifying uncertainties and absences of expected categories/constructs (Hurd, 2001). The heat maps provide visual and numeric data co-occurrences so that, in large-scale research, the data can be analyzed quantitatively; however, in smaller-scale studies such as this one, it can be used in a primarily qualitative fashion (Hudson, 2014). Analysis can then be supported with additional methods such as upward laddering to explore goals and values and/or downward laddering to "unpack vague or subjective terminology" (Rugg & Gerrard, 2023, p. 67).

Procedures

Our implementation of single-criterion card sorting is unique based on 1) selection of facilitators, 2) selection of images, 3) sorting into two piles, 4) avoiding the elicitation of the participants' sorting categories/explanations, 5) data processing, and 6) analysis. These conditions were followed based on guidance from the published literature on card/pile sorting (see above) and were afterward critically examined to identify gaps in that published guidance. This was done by having the implementation performed by team members without previous experience with card sorts and then additional critical examination performed by other members, one of whom had considerable experience in using card sorts. The involvement of novice and expert card sorters is an important issue for knowledge transfer and for research within the Global South; the published guidelines on any method will assume that some points are not worth mentioning or can be taken for granted and, therefore, will not need to be explicitly articulated. The omission of these and other types of semi-tacit knowledge can be a significant barrier to knowledge transfer (Maiden & Rugg, 1996).

Selection of Facilitators

The facilitators for the DHH and Kabyle card sorting were members of the respective communities who participated in this pilot. As mentioned above, Dr. Touati grew up in the Kabyle community. Ms. Mcleod and Ms. Richardson are both members of the DHH community and work for SDHHS. For training, Dr. Touati met online with Professor Traxler, Ms. Footring, and Dr. Koole, while Ms. Mcleod and Ms. Richardson met in person with Dr. Koole along with an ASL interpreter.

Selection of Pictures

For each community, a collection of images of learning events was procured through the facilitators. SDHHS offered a set of images taken during a past event in which DHH members gathered to learn how to make bows (for archery). The Kabyle community facilitator photographed images of women who gathered to learn how to prepare a traditional couscous dish. Each image was numbered. The facilitators shared the photo collections with the research team, selection of the final images was negotiated with the facilitators (Table 1). The final sets of images were in colour and showed at least one person engaged in the learning activity. To ensure that sorting would be based on the content of the photos rather than their format, each collection was either all landscape or all portrait (as much as possible), all the same size, all colour, and all had a white border.

Table 1. Number of Images Per Community

Community	Number of images	Topic
SDHHS	25	Learning to make bows
Kabyle	30	Learning to prepare a couscous dish

Data Collection and Analysis Procedures

Data collection follows the steps as outlined in Figure 2: 1) the participants sorted the cards according to the instructions provided by the facilitator (described below), 2) the facilitators documented the cards sorted into each pile for each sorting and the total number of sortings, 3) the sorting data for all participants was put into a spreadsheet, 4) the custom-programmed software analysed the spreadsheet producing a heat map of co-occurrences, 5) co-occurrences above the 80% (high) and below the 20% (low) thresholds were identified on the heat maps, 6) for high and low co-occurring cards, in-depth descriptions of the cards were produced and compared, and 7) the team discussed the identified patterns and card details to determine possible reasons for high and low co-occurrences.

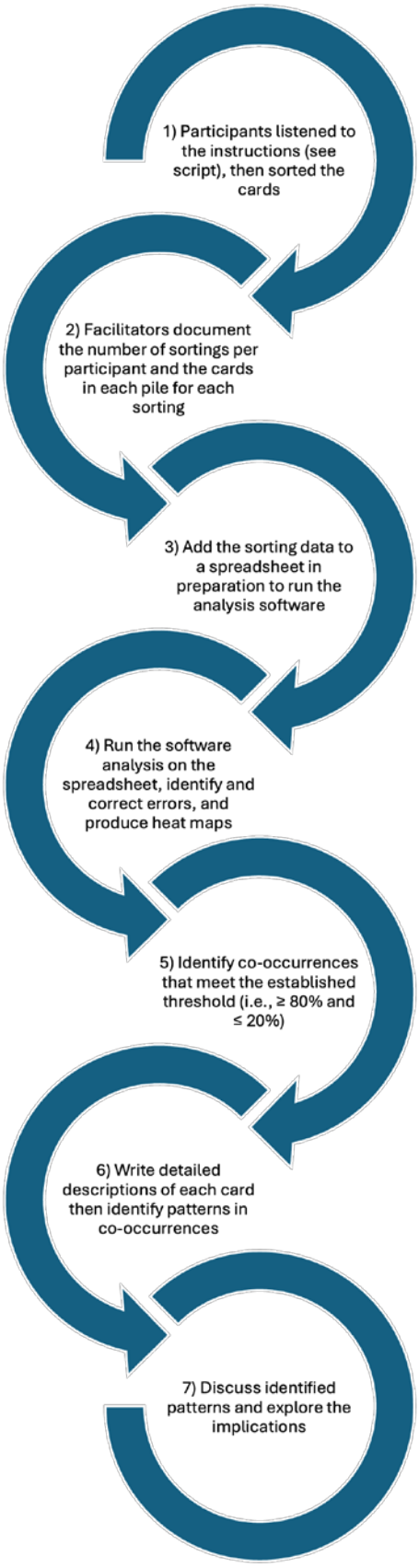

Figure 2. Data Collection and Analysis Procedures

Script / Instructions

The facilitators were given a script to help them explain the procedures to the participants (translated into both ASL and Kabyle). (The script in Appendix A was modelled closely upon Rugg & McGeorge, 2005.) The participants were asked to examine all the images and think of one way or idea into which they could sort the images (i.e., one criterion at a time). They were asked to sort the cards repeatedly until they could no longer think of any additional ways to sort the cards. After each sorting, the facilitator would record the picture numbers in each pile. The participants were allowed to ask questions about the method but were not asked to reveal the criterion for each sorting. The facilitators avoided soliciting the sorting criteria to allow the participants freedom to sort according to criteria for which they may lack words. In other words, we wanted to open avenues for the participants' non-linguistic intuition.

Data Processing

When the data from the SDHHS and Kabyle groups were returned from the facilitators, the card numbers were manually added to an Excel spreadsheet in a machine-readable format. One researcher read out the numbers and checked input while another researcher typed. The Excel spreadsheets were opened with our custom-designed Java software. The Java software detected anomalies such as repeat numbers and missing numbers—thereby helping to ensure accurate data entry and documentation of anomalies. The software produced colored heat maps for each participant and one aggregating the sortings for all participants, showing percentages of co-occurrences between individual cards (Appendix B).

Analysis

To familiarize oneself with the context and content of the cards/images, analysis can start with writing descriptions of each card. In analyzing the two sets of cards, we used hand-written notes describing the foreground and background (Figure 3). Because both the SDHHS and Kabyle collections were photographs of actual events, there was a substantial amount of detail.

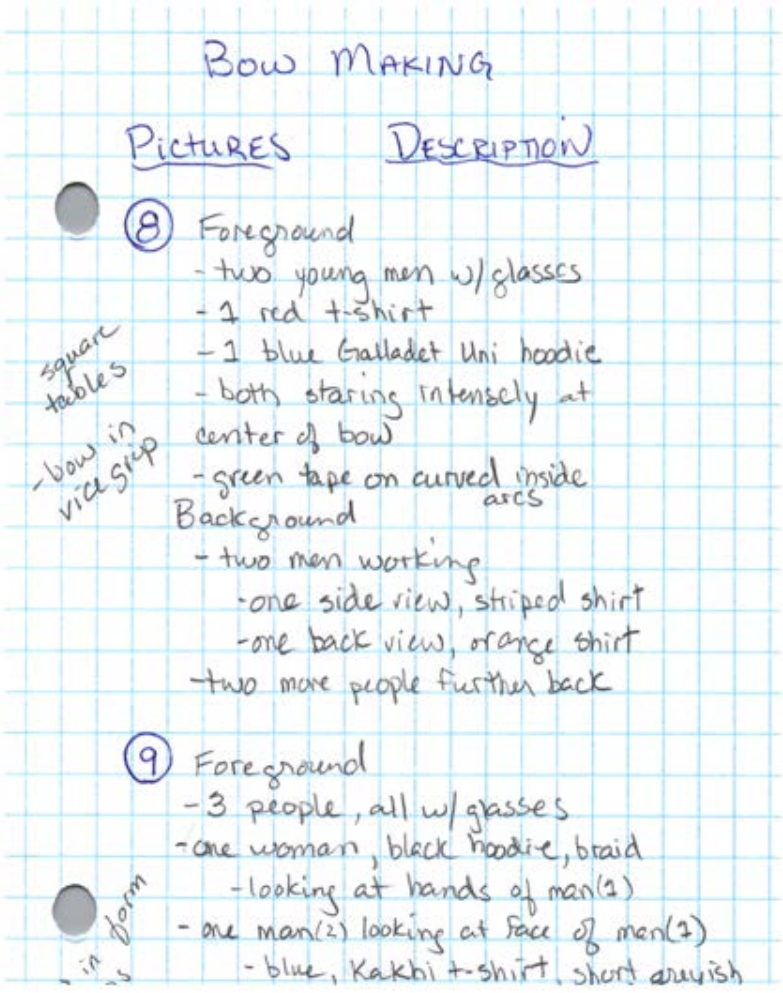

Figure 3. Note-taking and examination of the pictures.

After careful examination and writing detailed notes about each photo, we examined the heat maps (see Appendix B). Because this study was a pilot and had few participants, we decided to look at co-occurrences below 20% and above 80%. We used hand-written notes to jot down observations (Figure 4).

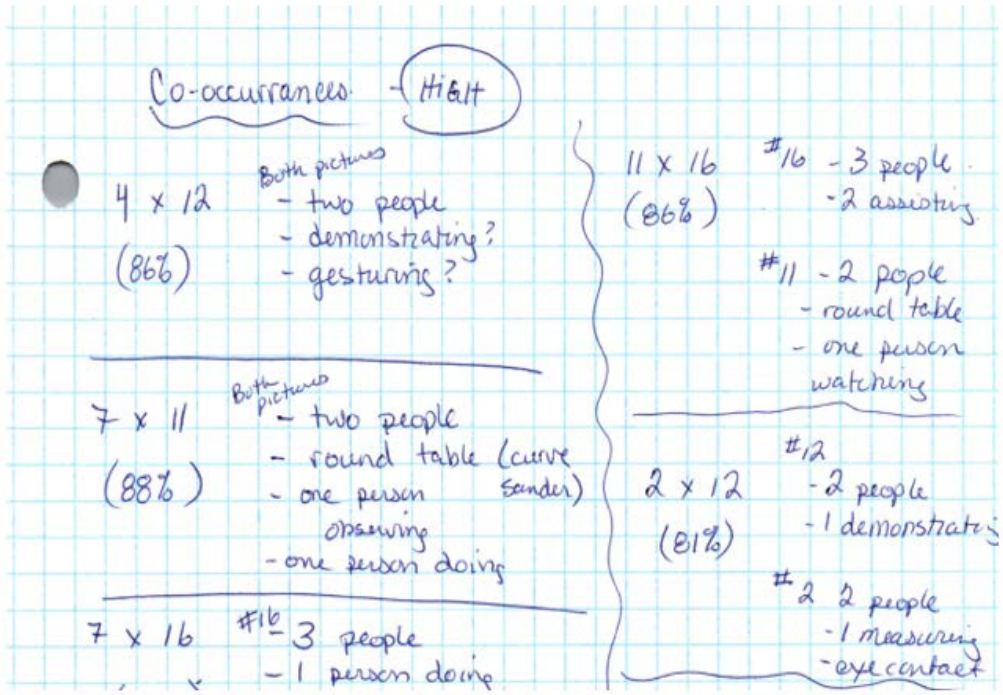

Figure 4. Bow-making pictures; high-occurrence notes.

Findings/Results

The initial data collection so far has resulted in 16 Kabyle participants and 7 from SDHHS. The inclusion criteria for participation were that the participants had to be part of the community; that is, for the Kabyle sorting, the participants had to be Kayble, and for the SDHHS sorting, they had to be DHH.

Number of Sortings Per Individual

The card sort literature routinely analyses the number of sorts performed by each participant and the number of piles used for each sort by each participant as indicators of, e.g., the extent of domain knowledge and domain complexity. As can be seen in Table 2, the number of sortings per individual was around 3.3 and 3.4 on average.

Table 2. Number of Sortings Per Individual

Kabyle		**SDHHS**	
Participant	**Number of Sortings**	**Participant**	**Number of Sortings**
1	3	1	4
2	2	2	3
3	2	3	4
4	4	4	3
5	4	5	3
6	1	6	3
7	2	7	3
8	4		
9	4		
10	8		
11	3		
12	3		
13	4		
14	5		
15	3		
16	2		
Average	**3.4**	**Average**	**3.3**

Co-occurrences

As can be seen in Table 3, the rates of co-occurrences were much higher for the Kabyle than SDHHS. This may be partly because of the number of participants and partly because of the categories that were sorted. In both cases, the sorting results, as indicated in the heatmap matrices, appear to be non-random, as patterns are easily visible.

Table 3. Rates of High and Low Co-occurrences

Co-Occurrences	SDHHS	Kabyle
Low ≤ 20%	10	18
High ≥ 80%	11	64

SDHHS Bow Making

Having examined the highest co-occurrences (≥80%) and lowest (≤20%) for the bow-making picture sorting, the highest co-occurrences included pictures in which one person was demonstrating or showing something (a process, a result, an object) to one or more other people. In such pictures, there was often eye contact or people looking at someone's hands, and sometimes an indication of a gesture (perhaps ASL).

There were two categories of pictures with the lowest co-occurrences. In one case, one picture would depict people interacting while the other card depicted people looking down, doing their own work (i.e., not talking, showing, or demonstrating anything; no eye/face contact). In the second case, the pictures depicted a bow in a different stage of manufacture. For example, one card showed someone sanding wood, while the other card would show someone bending wood around a curved form.

Kabyle Couscous Cooking

In our analysis of the Kabyle sortings, we also examined the highest (≥80%) and lowest (≤20%) co-occurrences. In the high co-occurring pictures, one woman who was wearing a white, embroidered smock was central in many of the pictures. This woman was often seen with other, younger women gathered around her. The woman in white was sometimes standing and sometimes sitting while the younger women were always sitting. At times she was handing or showing samples of vegetables and grains of couscous to another woman.

The main criteria for the majority of the sortings, both high and low occurring, appeared to be based on ingredients. Images with couscous were sorted together at higher rates. Images with vegetables were sorted together at higher rates. Images of cooking in water in the kitchen were sorted together at higher rates. The images that were seldom sorted together (i.e., less than 20%) were pictures-with-wet-ingredients (i.e., vegetables and chicken) with pictures-with-dry-ingredients (i.e., couscous).

Discussion

The main goal of this pilot was to explore the use of single-criterion card sorting as a method for eliciting knowledge from/with people from different cultural and linguistic traditions. Our aim is to explore what 'learning' means, how people traditionally learn within their communities, and what their preferences for learning are. While the results above are unsurprising, they are also non-random—that is, we were able to detect distinct patterns in the heat maps even with low participant numbers. The sorting method works, but does it work in helping us understand 'learning'? And does it help us understand how to design for learning?

The Kayble sortings were primarily based upon ingredients: wet versus dry, and there was an indicator of one or two individuals being the main teachers, with younger people listening to the older. The focus on the ingredients might suggest that we needed to emphasize our interest in 'learning' more clearly in the script (Appendix A). The SDHHS sortings highlighted the importance of looking at each other (i.e., face-to-face contact) and looking at hands in communication.

Selection of Pictures

As mentioned earlier, card sorting can be used to explore abstract concepts such as learning Rugg and McGeorge (2005). 'Learning' is an abstract construct. However, it is a process; images are snapshots in time. Through multiple discussions, our research team grappled with the issue of how to select images of learning. We also contemplated how to choose the learning topic; that is, 'learning of what'. We questioned whether bow-making or couscous cooking would be good subjects. To explain, the bow-making workshop is highly meaningful to anyone who participates. However, for anyone who is unfamiliar with carpentry, it can be difficult to know what the processes are. Because we were interested in the learning aspect as opposed to the actual carpentry, the subject of card sorting may have allowed us to better capture the importance of communication style among deaf learners. The Kabyle sorting, on the other hand,

offered familiar items and may have led to sorting based on the ingredients. The ingredient criterion may be culturally significant but cannot be known without implementing other research methods, such as laddering (below).

As can be seen in Table 2 above, the average number of sorts per participant was just over 3 on average. Typical numbers of sorts per participant are about 7; lower numbers of sorts (e.g., 2) typically indicate little knowledge of the domain, and higher numbers (e.g., 9 to 20) are usually indicative of expertise in the domain. The number of piles into which the cards are sorted sometimes varies noticeably between groups of participants. We need to assess multiple factors to ascertain why the average card sortings per participant were low. It is possible that the pictures require editing. For example, the background clutter can be removed. The types of pictures and their relationship to learning may need clearer relevance.

Our process for image collection identified a gap in the published guidelines for this part of the process. The images taken by the facilitator were technically good in terms of focus, depth of field, etc. From the viewpoint of card sorting, however, each image contained a high number of entities, which were possibly confusing or distracting for our participants. Re-examining the card sorts (pile sorts) literature made it clear in hindsight that the researchers had typically used images with a deliberate minimum of background features to avoid this problem. Gerrard and Dickinson (2005), for instance, studied perceptions of women's working dress and used cropped images that showed only the clothing, not the background. Similarly, Molnár (2012) used images showing types of terrain/vegetation without people or machinery in the scene. These insights will inform future card sorting studies.

Category Names

We hypothesized that using card sorts while deliberately not recording the category names or sorting criteria makes it possible to gather data on types that people might otherwise not be willing to talk about openly or for which they may lack vocabulary. The participants did not appear to have any problems with this, and it is an approach worth considering for future studies, particularly on sensitive topics. Interestingly, a significant proportion of the male participants in Gerrard and Dickinson's study (2005) spontaneously chose to perform one of their sorts using the criterion of married/unmarried and did not appear to consider this to be embarrassing. For exploring sensitive issues, Maiden and Rugg (1996) suggest using projective approaches, where participants are asked to perform the task as if they were someone else (e.g., performing card sorts as if they were a dishonest employee). There is a risk that the results might reflect social stereotypes rather than reality, but this approach can identify possibilities worth further exploration with other approaches, such as indirect observation (Maiden & Rugg, 1996).

Rugg and McGeorge (2005) warn against trying to investigate sequencing procedures, trade-offs, knowledge hierarchies, and tacit knowledge because these can involve complex construing, so we did not attempt this within the study described here. For activities such as bow-making and food preparation, though, it would be interesting to investigate whether card sorts could be adapted to investigate processes.

Moving forward, we plan to begin asking the participants for their category names and sorting criteria, even though it can result in extra complexity in recording and analysis of the data. The participants appeared comfortable with sorting without giving category names or sorting criteria, and there are intriguing possibilities for using this approach to investigate sensitive topics. However, we considered that these strong points were outweighed by the disadvantages of not knowing which features of the images were or were not important to the participants and of not knowing how the participants were construing the images. This was particularly obvious when trying to make sense of the heat maps. The literature on card sorts/pile sorts shows clearly that participants 'construing can be completely unexpected to the researchers but often makes complete sense to the researchers once they see it. In the case of the findings from this pilot study, we had to draw upon our own (i.e., researchers') knowledge to try to understand the patterns in the heatmap matrices. Inadvertently, then, we added our bias into the analysis process. Eliciting the participants 'category names can help researchers surface the participants 'taken-for-granted knowledge and avoid overlaying the researchers 'conceptions.

Projective Application

We would also like to repeat the data collection protectively (i.e., imagine that you are deaf) with, for example, teachers, interpreters, or Western college students. For instance, if some cards showing activities are clustered together by the DHH participants but not by the hearing participants, or vice versa, this implies that the clustering relates to societal beliefs and understandings, which are different between the two groups of participants.

Number of Piles

In addition to soliciting the categories and criteria, we are also re-considering the number of piles. In our implementation of card sorting, we limited the number of piles to two. The usual practice in the card-sorts community is to tell participants that they can sort the cards in as many or as few groups as they wish in each sort (Gerrard & Dickinson, 2005; Rugg & McGeorge, 2005). The literature consistently suggests that participants are comfortable with multiple piles and will spontaneously use fewer or more groups at will, including occasional cases where a participant

puts all the cards into one group, and says that there are no cards from a named other group. Variation in the number of piles implies that the participants not simply dutifully performing a task that they consider meaningless just to please the researchers, but rather are cognitively and intellectually engaged in the task. Granting participants' the freedom to sort into any number of piles, however, comes with a trade-off: added complexity in analysis.

The added complexity may be worthwhile; multiple piles can reveal interesting patterns. Gerrard and Dickinson (2005), for example, found that the male participants in their study mainly sorted cards into two piles, whereas the female participants made much more extensive use of multiple piles of cards within each sort. Similarly, Hurd (2001) found cross-cultural differences with Egyptian students typically sorting cards into multiple piles, and Chinese students mainly sorting into two groups. Subsequent analysis found that the two-pile/multiple-pile distinction was a real phenomenon rather than a statistical accident, and that it was not a simple gender effect, expertise effect or culture effect, but could rather have multiple causes.

One insight which emerged from our discussion about pile numbers caused us to revisit the "demonstrate the process" step recommended by Rugg and McGeorge (2005), in which the researcher demonstrates card sorting using cards from a completely different domain, to reduce the risk of cueing the participants towards particular criteria or categories within the domain being investigated in the main card sorts. It emerged in our discussion that some card-sorts researchers deliberately demonstrate the sorting process using more than two piles in one of the two demonstration sorts and two piles in the other, to show non-verbally that both multiple piles and two piles are acceptable. It also emerged that some researchers deliberately hesitate part-way through one of the demonstration sorts, and change the number of piles at that point, to demonstrate non-verbally that it is okay for participants to change their minds mid-way through the sort. This type of deliberate use of non-verbal instruction, and of incidental learning, does not appear to have received much attention in the literature.

Complementary Methods

Finally, we will add one additional method to our card sorting: upward laddering. Upward laddering (Hinkle, 1965) is a method that was originally based on Kelly's Personal Construct Theory (Kelly, 1991, 2017) to investigate people's goals and values. It was soon adopted and adapted by other fields, such as market research (Reynolds & Gutman, 2001) and knowledge elicitation (Rugg & McGeorge, 2005). In its most widely used forms, it explicitly draws on graph theory and facet theory to provide a flexible, powerful underlying knowledge architecture grounded in a well-established mathematical and computational tradition (Rugg & Gerrard, 2023).

Upward laddering typically begins with a small number of choices (typically two or three), such as images from a card/pile sort, or group names from a card/pile sort. The researcher then asks the participant which of these they would prefer, and why (the first step up the ladder). Once the participant has replied, the researcher then asks why that reason is important to them (the second step up the ladder). This process continues until either the ladder moves into an area that the participant considers sensitive, or for a pre-chosen number of steps, or until the participant has reached a point of saturation.

Sensitive territory can be reached surprisingly quickly; for instance, a participant saying that they would prefer Job A over Job B because Job A provides better pay and lets them travel (Figure 5). Upward laddering, used with care, can swiftly identify situations where different individuals share the same goals and values at a higher level, even though they disagree at a lower level. It can also help identify different routes to a high-level goal when a person has become stuck trying to achieve a lower-level goal and has lost sight of the bigger picture.

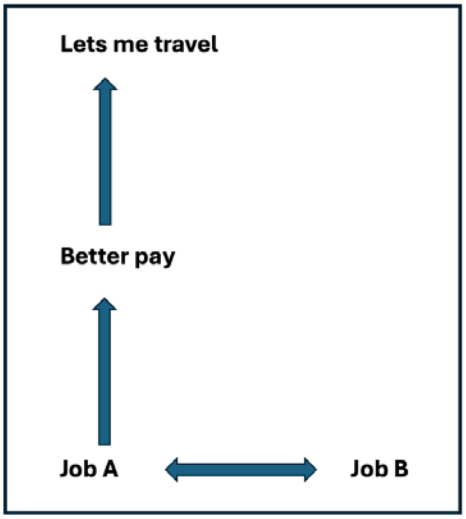

Figure 5. Upward Laddering

The usability and human-computer interaction literature recommends using card sorts and laddering in combination (Rugg & Gerrard, 2023) with card sorts to find the categories and constructs that matter to people, and laddering to find out why those categories and constructs matter to them. Anecdotally, participants who use both methods find card sorts enjoyable and interesting, and find laddering more demanding, though interesting. This difference in feedback suggests that the positive responses to card sorting are not just a "good subject" attempt to please the researchers. Although upward laddering is a useful tool for exploring the goals and values of marginal groups, it depends heavily on language, so it will be interesting to see what happens when it is used in the Kabyle and DHH contexts.

Selection of Facilitators

An important aim of our work is to include on the research team members of the communities with whom we are working. It is logistically more attractive for working with communities in other countries because it reduces cost and travel time. More importantly, people with in-depth knowledge and expertise in relevant linguistic and cultural traditions should help to steer the research in useful directions for the communities. In addition to flattening the power hierarchies, involvement of the community should also empower community members to design, implement, assess, and disseminate research findings.

Engaging in Ethical Practice

The ethical dimension is inseparable from the methodological dimension. As per our institutional practices and procedures, we sought permission from an ethics board, we followed consent procedures, and as per recommended, we sought permission from the local organizations. Our team discussions led us, however, to question our institutional expectations, both about the consent process and the expectations about the necessary formality or actual existence of 'local organizations'. Even though our local facilitators could translate and explain our institutional research procedures and consent forms, the nature of one-off informed consent from isolated individuals is a European or western concept, and not always appropriate in other cultures. However, developing more appropriate ethics procedures to proceed with the proposed research was itself a research process and so there was a potential deadlock: neither ethics nor research could proceed without progress on either one as they are inherently intertwined.

To an extent, inviting local facilitators to advise, guide, and collect data helped us mediate between Western institutional practices and local practices and so the deadlock can be progressively and incrementally resolved as mutual understanding increased but only on a community-by-community basis. Moreover, the fluidity, transience and informality of groupings within some cultures, means the institutional emphasis on 'local organisations might add another dimension to groups that are 'hard-to-reach' because they lack the necessary 'organization'.

Conclusion

This pilot is part of a much larger endeavour, the "Decolonization of Digital Learning Spaces" project. The purpose of the project is to provide a suite of research tools for communities to use and for researchers to access when working with communities who are remote and/or excluded not only geographically but also politically, economically, socially, culturally, and linguistically. Using these tools and methods, we hope to support them and us in accessing their own knowledge and skills. The long-term goal is for communities to design their own digital learning tools, networks, and environments. Testing the single-criterion card sorting method is the first step toward this larger goal.

The Decolonisation of Digital Learning Spaces project started from observations that educational technology grows out of educational research and out of educational theorising. If any research approaches are to provide disparate marginal communities with educational technologies that are culturally appropriate and culturally sensitive, then we must go right back to the research methods that should be providing the meaningful and authentic shared understandings needed as the starting point—and with attention to addressing the practical concerns of reaching communities that are by definition 'hard-to-reach'. Understandably, the current project was exploratory. It nevertheless provided several findings that are solid foundations and promising beginnings:

i. Working with the two communities represented here and with others elsewhere suggested that it is possible to establish a global network of similar communities with a shared commitment to the principles and ideals just set out.

ii. Working with local facilitators and using methods such as card sorts, selected on the criteria mentioned earlier, suggested that within such communities, it is possible to train, support, and empower the facilitators, making them meaningful co-researchers (and co-authors in the current case).

iii. This small-scale work suggests that card-sorts are a potentially useful research tool in the current contexts, justifying scaling-up and further resources; within the limitations, observations, and recommendations outlined earlier, card-sorts provide insights into the personal constructs and mental models of disparate communities around their conceptions of knowing and learning.

iv. It is quite possible that other tools will emerge from other disciplines for use alongside card-sorts and that these will slot into the established format.

The significance of this work is establishing local but cost-effective alternatives to methods and solutions imposed or imported from the mainstreams of the global North; the longer-term ambition is to establish a transferable and adaptable method with card-sorts amongst a range of tools to explore local learning needs and aspirations, but also through parallel work on governance and ethics, to create a global community from which the original 'Western' team could gradually and ultimately withdraw.

As a method for reaching our research goals, we found card sorting to be an easy, enjoyable, and inexpensive means of collecting and analysing data. Working with people located in remote areas with little or no access to electricity or the Internet, card sorting is accessible and doable. Our aim is to continue to work with the DHH and Kabyle communities towards using additional methods and exploring how to design digital learning spaces. While the findings from this pilot are modest, card sorting has allowed us to establish our relationships, develop lasting relationships with the communities, better understand the research context, and gain insights regarding logistics.

Limitations

One advantage of card sorts is the willingness of researchers to adopt a low-tech methodological approach; it is an approach that can be understood and used quickly by both researchers and participants, leading to swift data collection, interpretation, and upward laddering. A specific challenge of card sorts is getting the right images. We have discussed at length whether they should all be the same size, single focus, all in colour, all landscape, etc. Our recommendation is that researchers work with a small pilot group to understand community preferences here. We have only used two community card sorting events, but the non-randomness of the data collected (i.e., visually discernable patterns) shows clear potential for future research to be conducted with similar groups in multiple contexts. We posit that the discussions and the findings so far contribute to a widening conversation around effective methodological approaches for use with marginalised communities and in developmental contexts.

Recommendations

In this project, our team explored variations of card sorting procedures. As a result of our work, we offer the following practical recommendations to future researchers:

- Images with minimal background features are preferable to avoid confusion, as high-entity images can be distracting.
- Participant-elicited category names and criteria may help avoid researcher bias and better understand participant perspectives.
- Projective techniques can be tested as a means to reveal societal beliefs and understandings that differ between participant groups.
- Allowing multiple piles, despite added complexity to the data gathering and subsequent analysis, can reveal interesting and unexpected patterns and insights.
- Upward laddering after card sorting can help explore participants' goals and values by asking why specific choices are important.
- Including community members as researchers to help steer the research in useful directions and empower the community.
- Involving local facilitators helped mediate between Western and local practices, gradually resolving ethical and research challenges.
- Ethical considerations are intertwined with methodological practices, requiring mutual understanding between researchers and communities.

Ethics Statements

This study involved human participants. This research project was approved on ethical grounds by the University of Saskatchewan Behavioural Research Ethics Board (certificate of approval identification #3414). Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office: ethics.office@usask.ca; 306-966-2975; out-of-town participants may call toll-free 1-888-966-2975.

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Conflict of Interest

The authors declare no conflicts of interest. All co-authors have reviewed and approved the manuscript. There are no financial interests to report. This submission is original work and is not under review by any other publication.

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Authorship Contribution Statement

Koole: Conceptualization, design, analysis, writing, supervision. Rugg: Analysis, writing, editing, advising on methodology. Traxler: Conceptualization, design, editing/reviewing. Smith: Advising on design, analysis, writing, editing/reviewing. Touati: Data collection, writing, reviewing. McCleod: Data collection, writing, reviewing. Richardson: Data collection, reviewing. Footring: Editing/reviewing, advising on methodology.

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Appendix A:

Sample Script

You will be given some pictures to sort. All the pictures are from [learning activity]. The goal of this card sorting activity is to explore 'learning'.

Please take a few minutes to examine the pictures. Consider what people are doing, what objects are there, what surrounds them, etc. As you examine the pictures, think about learning; who is learning; what they are learning; how they are learning.

I would like you to sort the pictures into two piles, using one criterion [one reason/category] related to [learning activity]. Any criterion you choose is fine. If cards don't fit into the two piles, you can leave them out. There are no right or wrong answers.

When you have finished sorting, I will write down which pictures went into each column.

Once I have written it down, I would like you to sort the cards again, using a different criterion. I will ask you to sort the pictures over and over until you can't think of any other ways to sort them.

During this activity, you are welcome to use any criteria you like, and any groups you like, including 'don't know', 'not sure' and 'not applicable'. The main thing is to use only one criterion in each sort – please don't lump two or more criteria/ideas in together. If you're not sure about something, just ask.

You may have noticed that the cards are numbered: this is for convenience when recording the results. The numbering is random, so please don't use that as a criterion for sorting!

If you have any comments or questions, then please let me know.

Thank you for participating.

Appendix B:

Sample heatmap generated from bow making learning event